U.S. Department of Transportation

Federal Aviation Administration

Memorandum

Subject: **ACTION**: Cabin Pressurization – Exceedance of 15,000 Foot Cabin Altitude Limit; ELOS Number ACE-00-05

Date: June 19, 2000

From: Carlos Blacklock, Program Manager, ACE-117W, Wichita Aircraft Certification Office

Reply to Attn. of:

To: Manager, Project Support Section, ACE-112, Small Airplane Directorate

BACKGROUND

In accordance with the provisions of FAR § 21.21 (b)(1), Cessna submitted a request, as follows, for an equivalent level of safety to the requirements of FAR § 23.841 (a) when applied to the Cessna Model 525A. Cessna wishes to obtain approval for a Cabin Pressurization System that allows temporary excursions above the 15,000 foot altitude limit following any probable failure. Cessna has a cabin pressure control system that they believe will provide an equivalent level of safety to the requirements of FAR § 23.841(a).

DISCUSSION OF APPLICABLE REGULATIONS

A literal non-compliance to 14 CFR 23.841(a) amendment 17 was discovered during flight testing of the Cessna model 525A. With a controller failure, the cabin altitude exceeds the maximum allowable cabin altitude of 15,000 feet. The cabin altitude exceeded the limit for seven seconds reaching a maximum of 15,745 feet.

CESSNA POSITION

Refer to Cessna letter L178-61-98-1338, dated June 1, 2000.

In normal operation the Model 525A Cabin Pressure Control System (CPCS) maintains a Cabin Pressure Altitude (CPA) of 7800 ft. In the event of failures in the CPCS leading to a loss of cabin pressurization, the flight crew and passengers must be protected from cabin pressure altitudes that could result in crew incapacitation or permanent injury to passengers.

CESSNA POSITION, CONTINUED

The language of 14 CFR §23.841 states: (in part)

(a) If certification for operation over 31,000 feet is requested, the airplane must be able to maintain a cabin pressure altitude of not more than 15,000 feet in event of any probable failure or malfunction in the pressurization system.

The Model 525A CPCS is equipped with cabin altitude limiters on each outflow/safety valve, which are designed to prevent any failure or malfunction in the CPCS from causing the CPA from exceeding 15,000 ft. When the critical CPCS failure (simulated by command of cabin pressure dump) was tested, the CPA exceeded 15,000 ft for 7 seconds, reaching a peak CPA of 15,745 ft. The cause of this exceedance is that the CPA climb rate exceeds the limiter's response rate.

Compensating factors which we believe provide an equivalent level of safety to the requirements of 14 CFR §23.841(a), as required by 14 CFR §21.21(b)(1), for the Model 525A are outlined in the following :

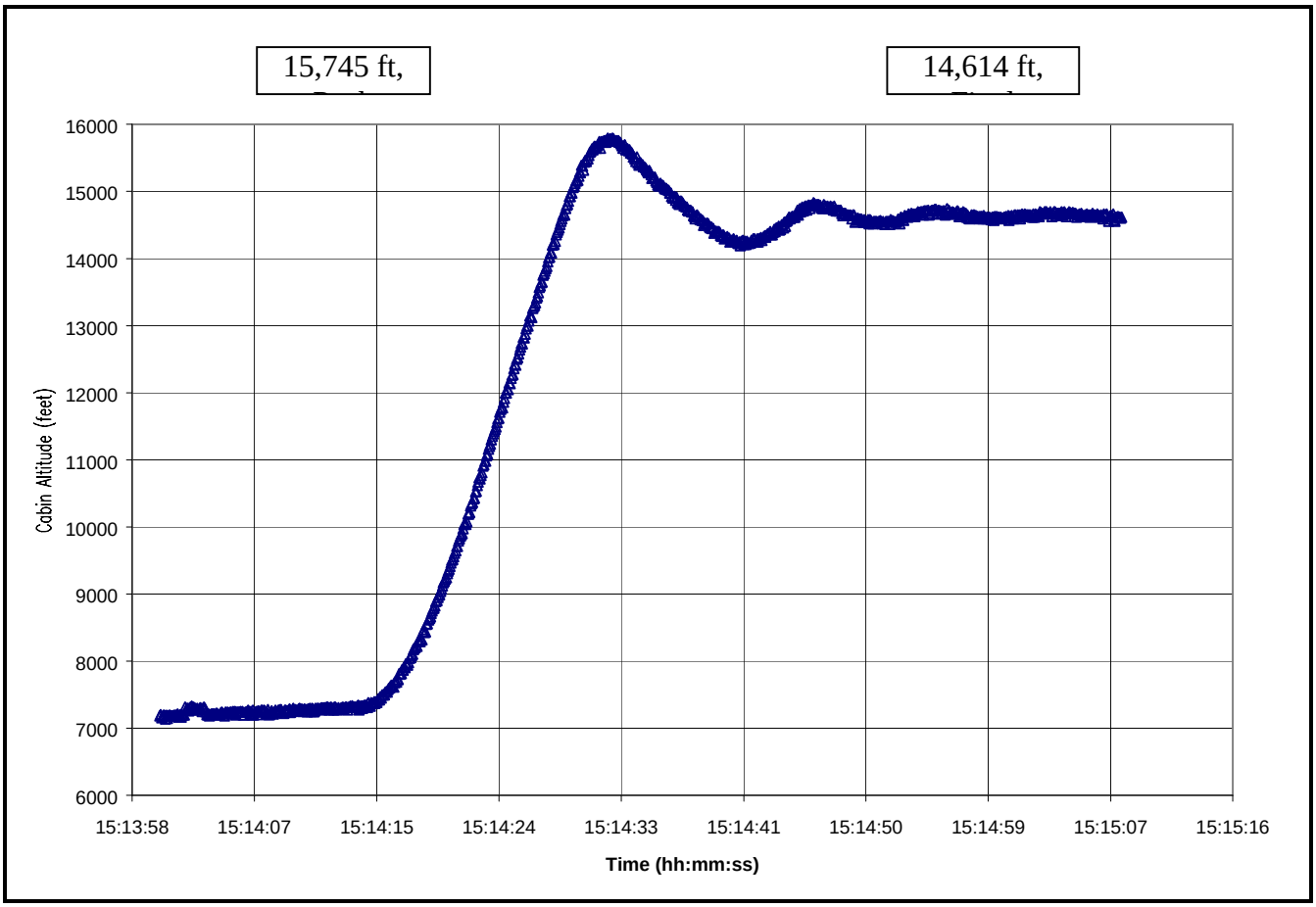
1. Review of physiological data contained in FAA Advisory Circulars AC25-20 and AC91-8B and SAE Reports AIR822 and AIR825B shows the severity of hypoxia effects increase progressively with increasing CPA and duration of exposure. The effects are cumulative; rate of onset and severity of symptoms increase in proportion to increase in CPA. Conversely, severity of hypoxia effects decrease in proportion to decrease in CPA.

2. Review of Model 525A flight test data in the attached chart shows the duration and magnitude of the CPA overshoot above 15,000 ft is less than the duration and magnitude of the oscillations below it. Therefore, the hypoxia effects resulting from CPCS failure or malfunction will be no greater than the effects of a similar rapid climb in CPA to the stabilized CPA of 14,614 ft, which is below the limit of 15,000 ft specified by 14 CFR §23.841(a).

3. CPA climb to the setting of the cabin altitude limiters will be accompanied by warning annunciation of excessive cabin altitude and auto-deploy of the passenger oxygen masks. AFM procedures require flightcrew to don their oxygen masks and initiate an emergency descent. This prevents exposure of the occupants to CPA that could cause a hazard.

The intent of 14 CFR §23.841(a) is to prevent exposure of the occupants to CPA that could prevent the flightcrew from safely flying and landing the airplane, or cause permanent physiological injury to the occupants. The design and the tested performance of the Model 525A CPCS meet this intent. Therefore, it is felt that the features provided by the Model 525A CPCS provide an equivalent level of safety to that specified by 14 CFR §23.841(a). Your concurrence is respectfully requested.

CESSNA POSITION, CONTINUED



References

AC25-20	Pressurization, Ventilation and Oxygen Systems Assessment for Subsonic Flight Including High Altitude Operation
AC91-8B	Use of Oxygen by Aviation Pilots/Passengers
SAE AIR 822	Oxygen Systems for General Aviation
SAE AIR 825B	Oxygen Equipment for Aircraft

FAA POSITION

Cessna has presented three items as compensating factors on which they base their request for an Equivalent Level of Safety. The first item is supporting data for the second and cannot be considered as a compensating factor in itself. The second item does present compensating factors. Cessna shows that their cabin pressurization control system compensates for exceeding the 15,000 foot cabin altitude limit by providing the occupants with a cabin altitude lower than 15,000 feet prior to and after the small excursion. The third item presents features that are already required by the regulations. While it is important that these features remain properly functional, their use cannot be considered a compensating factor in an Equivalent Level of Safety.

FAA POSITION, CONTINUED

The FAA believes that in the specific case that Cessna has presented above, the compensating factors warrant an Equivalent Level of Safety. In this case, the peak altitude and duration of the exceedance are small in magnitude, and the altitude is immediately reduced to a level below 15,000 feet by an amount greater than the exceedance.

RECOMMENDATION

The introduction of probable failures into the Model 525A cabin pressurization control system (CPCS) were found to cause small excursions above 15,000 feet. In these cases, the peak altitude and duration of exceedances were observed to be small in magnitude, and the cabin altitude is immediately reduced to a level below 15,000 feet by an amount greater than the exceedance. These compensating features are deemed adequate to warrant the grant of an Equivalent Level of Safety.

Therefore, equivalent level of safety (ELOS) number ACE-00-05, may be granted to Cessna Aircraft Company for the Model 525A. This ELOS is granted with regard to FAR § 23.841(a), to allow small temporary cabin altitude excursions above 15,000 feet in the event of any probable pressurization system failure.

CONCURRENCE

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Carlos Blacklock, Program Manager, ACE-117W
Wichita Aircraft Certification Office

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Manager, Project Support Section, ACE-112
Small Airplane Directorate